

REMARKS

By the present amendment and response, independent claims 1, 17, and 44 have been amended to overcome the Examiner's objections. Claims 1-27, 29, and 31-55 are pending in the present application. Reconsideration and allowance of pending claims 1-27, 29, and 31-55 in view of the following remarks are requested.

The Examiner has rejected claims 1, 2, and 5-14 under 35 USC §102(b) as being anticipated by U.S. patent number 5,703,405 to Kenneth Arthur Zeber ("Zeber"). For the reasons discussed below, Applicant respectfully submits that the present invention, as defined by amended independent claim 1, is patentably distinguishable over Zeber.

The present invention, as defined by amended independent claim 1, teaches, among other things, "a support pad attached to said top surface of said substrate, said support pad being situated underneath said die, said support pad being coupled to said die by a down bonding wire." As disclosed in the present application, the support pad functions as a "ground plane" for the die by providing die ground bond pads with a large common ground connection. As disclosed in the present application, since the support pad is connected to a die ground bond pad by a substrate down bond area and a down bonding wire, the present invention advantageously achieves a minimal length electrical ground connection between the die ground pad and the support pad.

Moreover, as disclosed in the present application, the support pad is connected to a heat spreader by vias situated in the substrate. As a result, the present invention advantageously achieves a low resistance, low inductance, minimal length ground

connection between the support pad and the heat spreader. Additionally, the present invention advantageously provides thermal conduction of excess heat away from the die by way of the support pad, the vias, and the heat spreader.

In contrast to the present invention as defined by amended independent claim 1, Zeber does not teach, disclose, or suggest “a support pad attached to said top surface of said substrate, said support pad being situated underneath said die, said support pad being coupled to said die by a down bonding wire.” Zeber specifically discloses ceramic substrate 705 including contacts 710, which are coupled to terminals 715 formed on first surface 720 of an integrated circuit die by preferably utilizing flip-chip interconnect technology. See, for example, column 6, lines 24-32 and Figure 7 of Zeber. In Zeber, contacts 710 are situated underneath the die and are directly connected to terminals 715 on the bottom surface, i.e. first surface 720, of the die. See, for example, Figure 7 of Zeber. Moreover, by preferably utilizing flip-chip interconnect technology to connect contacts 710, which are situated underneath the die, to terminals 715 on the bottom surface of the die, Zeber teaches away from utilizing a bonding wire to couple contacts 710 to the die.

For the foregoing reasons, Applicant respectfully submits that the present invention, as defined by amended independent claim 1, is not suggested, disclosed, or taught by Zeber. Thus, amended independent claim 1 is patentably distinguishable over Zeber and, as such, claims 2 and 5-14 depending from amended independent claim 1 are,

a fortiori, also patentably distinguishable over Zeber for at least the reasons presented above and also for additional limitations contained in each dependent claim.

The Examiner has rejected claims 3, 4, 15, and 16 under 35 USC §103(a) as being unpatentable over Zeber. As discussed above, amended independent claim 1 is patentably distinguishable over Zeber and, as such, claims 3, 4, 15, and 16 depending from amended independent claim 1 are, *a fortiori*, also patentably distinguishable over Zeber for at least the reasons presented above and also for additional limitations contained in each dependent claim.

The Examiner has rejected claims 17-27, 29, and 31-55 under 35 USC §103(a) as being unpatentable over Zeber in view of U.S. patent number 5,942,795 to Lan H. Hoang (“Hoang”). For the reasons discussed below, Applicant respectfully submits that the present invention, as defined by amended independent claims 17 and 44, is patentably distinguishable over Zeber and Hoang, either singly or in combination.

The present invention, as defined by amended independent claims 17 and 44, teaches, among other things, “a support pad attached to said top surface of said substrate, said support pad being connected to said heat spreader.” As disclosed in the present application, by utilizing a support pad attached to a top surface of a substrate and connected to a heat spreader attached to a bottom surface of the substrate, the present invention advantageously achieves a low resistance, low inductance, minimal length ground connection between the support pad and the heat spreader. Additionally, as disclosed in the present application, the present invention advantageously provides

thermal conduction of excess heat away from a die situated above the support pad by forming a thermal conduit comprising the support pad, vias, and the heat spreader.

In contrast to the present invention as defined by amended independent claims 17 and 44, Zeber does not teach, disclose, or suggest “a support pad attached to said top surface of said substrate, said support pad being connected to said heat spreader.” In fact, Zeber does not even mention a heat spreader.

In contrast to the present invention as defined by amended independent claims 17 and 44, Hoang does not teach, disclose, or suggest “a support pad attached to said top surface of said substrate, said support pad being connected to said heat spreader.” Hoang specifically discloses heat sink 30 having two horizontal portions 34 that extend through substrate carrier 10 and terminate below bottom surface 24 of substrate carrier 10, where the two horizontal portions 34 are connected to the active surface of flip chip die 12 by thermal bumps 28. See, for example, column 3, lines 56-64 and Figure 3 of Hoang. Thus, in Hoang, heat sink 30 is directly connected through substrate carrier 10 to the active surface of flip chip die 12 by thermal bumps 28. However, Hoang does not teach, disclose, or suggest attaching a support pad to the top surface of support carrier 10 and connecting the support pad to heat sink 30. In fact, Hoang does not even mention utilizing a support pad.


For all the foregoing reasons, Applicant respectfully submits that the present invention, as defined by amended independent claims 17 and 44, is not suggested, disclosed, or taught by Zeber and Hoang, either singly or in combination. Thus, amended

independent claims 17 and 44 are patentably distinguishable over Zeber and Hoang and, as such, claims 18-27, 29, and 31-43 depending from amended independent claim 17 and claims 45-55 depending from amended independent claim 44 are, *a fortiori*, also patentably distinguishable over Zeber and Hoang for at least the reasons presented above and also for additional limitations contained in each dependent claim.

Based on the foregoing reasons, the present invention, as defined by amended independent claims 1, 17, and 44 and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, claims 1-27, 29, and 31-55 pending in the present application are patentably distinguishable over the art cited by the Examiner. As such, and for all the foregoing reasons, an early allowance of claims 1-27, 29, and 31-55 pending in the present application is respectfully requested.

Respectfully Submitted,
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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

Claims 1, 17, and 44 have been amended as follows:

1. (Once Amended) A structure comprising:

- a substrate having a top surface for receiving a die;
- a printed circuit board attached to a bottom surface of said substrate;
- a support pad attached to said top surface of said substrate, said support pad being situated underneath said die, said support pad being coupled to said die by a down bonding wire;
- at least one via in said substrate;
- said at least one via providing an electrical connection between a signal bond pad of said die and said printed circuit board.

17. (Once Amended) A structure comprising:

- a substrate having a top surface and a bottom surface;
- a semiconductor die attached to said top surface of said substrate;
- a heat spreader attached to said bottom surface of said substrate;
- a support pad attached to said top surface of said substrate, said support pad being connected to said heat spreader;

a first via in said substrate;

said first via providing a connection between said semiconductor die and said heat spreader.

44. (Once Amended) A structure comprising:

a substrate having a top surface and a bottom surface;

a semiconductor die attached to said top surface of said substrate;

a heat spreader attached to said bottom surface of said substrate;

a support pad attached to said top surface of said substrate, said support pad being

connected to said heat spreader;

electrical
connection

a first plurality of vias in said substrate;

said first plurality of vias providing a connection between said semiconductor die and said heat spreader.